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Indian Standard

IS 5561 : 2018

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(पहला पुनरीक्षण)

Electric Power Connectors — Specification

(First Revision)

ICS: 29.130.10

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High Voltage Switchgear and Controlgear Sectional Committee, ETD 08

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the High Voltage Switchgear and Controlgear Sectional Committee had been approved by the Electrotechnical Division Council.

This standard was first published in 1970. The revision of this standard has been taken up to align it with the latest practices. The major changes in the revised standard are as given below:

a) the connectors composed of aluminium alloy and other copper alloys have been included in the scope.
b) the following new type tests have been included:
    1) Visual corona and RIV test (for 132 kV and above voltage level) (*see* **15**).
    2) Cantilever strength test on bus support clamps and connectors (*see* **17**).

In the formulation of this standard, assistance has been derived from the following international/other standards:

ANSI/ NEMA CC1 : 2009	Electric power connectors for substation
BS 159 : 1992	Busbar and busbar connections
BS 3288-1:2014	Insulator and conductor fittings for overhead power lines: Part 1 Performance and general requirements
IEC 61284 : 1997	Overhead lines — Requirement and tests for fittings
IS/IEC 62271 (Part 1) : 2007	High-voltage switchgear and control gear — Part 1: Common specifications

The connectors covered in this standard are primarily intended to establish electrical connection between conductors, aluminium to aluminium or aluminium to copper or copper to copper conductors, between equipment and conductors, etc, in places like substations and generating stations. This standard does not cover fittings for insulators.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard
ELECTRIC POWER CONNECTORS — SPECIFICATION
(First Revision)

1 SCOPE

1.1 This standard covers uninsulated electric power connectors having current rating of 200 amperes and above and bus supports, which are Components of high tension, extra high and ultra-high tension a.c power systems and which are composed of such metals as aluminium, aluminium alloys, bronze and other copper alloys.

1.1.1 This standard is mainly intended for power connectors used in substations and generating stations.

1.2 In addition to plugs and sockets which do not come under the scope of this standard, the following types of connectors are also not covered.

a) Connectors for use in equipment for telecommunications and in electronic devices employing similar techniques.
b) Connectors for use in frequencies other than the power frequency of 50 Hz.
c) Connectors for use in transmission lines such as mid span compression joints.

2 REFERENCES

2.1 The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of these standards.

IS No.	*Title*
28 : 1985	Phosphor bronze ingots and castings
292 : 1983	Leaded brass ingots and castings
617 : 1994	Aluminium and aluminium alloy ingots and castings for general engineering purposes
1363 (All parts)	Hexagon head bolts, screws and nuts of product Grade C
1367 (All parts)	Technical supply conditions for threaded steel fasteners
1573 : 1986	Electroplated coatings of zinc on iron and steel
2629 : 1985	Recommended practice for hot-dip galvanizing of iron and steel
2633 : 1986	Methods for testing uniformity of coating of zinc coated articles
10052 (Part 1) : 1999	Specification for radio disturbance and immunity measuring apparatus and methods: Part 1 Radio disturbance and immunity measuring apparatus

3 TERMINOLOGY

3.1 For the purpose of this standard, the following definitions shall apply.

3.1.1 *Bimetallic Connector* — A connector designed for the purpose of connecting together two or more conductors of different materials (normally copper and aluminium conductors) for preventing electrolytic corrosion.

3.1.2 *Acceptance Tests* — Tests carried out on samples selected from a lot for the purpose of verifying the acceptability of the lot.

3.1.3 *Bus Support Clamps* — A connector designed for the purpose of connecting the conductor(s) to the support insulator.

3.1.4 *Conductor* — A piece of material of any shape, rigid or flexible, meant for the purpose of carrying current.

3.1.5 *Connector* — A component for the purpose of providing connection(s) through a suitable mating part between.

3.1.6 *Corona Extinction* — Voltage (or) conductor voltage gradient at which corona discharge cease during a decreasing test volt sequences.

3.1.7 *Corona Inception* — Voltage (or) conductor voltage gradient at which corona discharge initiate during an increasing test volt sequences.

3.1.8 *Equipment Connector* — A connector designed for the purpose of connecting the terminal of the equipment to the conductor(s). Terminal pad (or) Round terminal stud.

3.1.9 *Expansion Connector* — A connector designed for the purpose of connecting together two or more conductors and incorporating means to allow for any relative movement with ample allowance for the relative movement between the conductors.

3.1.10 *Junction Connector* — A connector designed for the purpose of connecting together two or more conductors whose axes are either in line with or at an angle to each other.

3.1.11 *Lot* — All connectors of the same type, category and rating manufactured by the same factory during the same period using the same process and materials.

3.1.12 *Parallel Groove Connector* — A connector designed for the purpose of connecting two or more conductors whose axes are parallel to each other.

3.1.13 *Rated Short Time Withstand Current* — The r.m.s value of the current during specified short time under specified conditions of use and behaviour.

3.1.14 *Rigid Connector* — A connector designed for the purpose of connecting together two or more conductors with no allowance for the relative movement between conductors.

3.1.15 *Routine Tests* — Tests carried out on each connector to check requirements likely to vary during production.

3.1.16 *Tee Connector* — A connector designed for the purpose of connecting two conductors whose axes are perpendicular to each other.

3.1.17 *Type Tests* — Tests carried out to prove conformity with the requirements of this specification. These are intended to prove the general quality and design of a given type of connector.

4 RATING

4.1 Rated Normal Current

The rated normal current of power connectors is the r.m.s value of the current which shall be able to carry continuously under specified conditions of use and behaviour and shall be selected from one of the following values:

- 200 A, 400 A, 630 A, 800 A, 1 000 A, 1 250 A, 1 600 A, 2 000 A, 2 500 A, 3 000 A or 3 150 A or as recommended by the conductor manufacturer.

4.2 Connector Classes

The connector class is based upon the system operating voltage as follows:

4.2.1 *HV (High Voltage)*

System operating voltage equal to or greater than 100 kV and equal to or less than 230 kV.

4.2.2 *EHV (Extra High Voltage)*

System operating voltage greater than 230 kV but less than 1 000 kV.

4.2.3 *UHV (Ultra High Voltage)*

System operating voltage equal to or greater than 1 000 kV

4.3 The rated frequency of the power connector shall be 50 Hz.

4.4 Rated Short Time withstand Current

The rated short-time withstand current shall be one of the standard values laid down in Indian Standards for the associated circuit-breakers, switches, etc.

NOTE — When power connectors are directly associated with a circuit-breaker or a switch, the rated short-time withstand current of the power connectors shall be not less than the corresponding rating for the circuit-breaker or switch.

4.5 Rated Peak withstand Current

The rated peak withstand current equal to 2.5 times the rated short time withstand current. For electric power connectors with rated voltages higher than 800 kV equal to 2.7 times the rated short time with stand current.

5 MATERIALS

5.1 All materials used shall conform to the relevant Indian Standards.

5.2 The chemical composition of aluminium and aluminium alloys used in the manufacture of the electric power connector and bus supports shall conform to designation 4600 of IS 617. Chemical composition of Bronze or other copper alloys shall conform to IS 28 or IS 292.

5.3 Steel bolts and nuts shall conform to IS 1367. Non-ferrous alloy bolts and nuts shall conform to IS 1363.

5.4 Spring washers shall be electro-galvanized mild steel suitable for at least service condition-3 as per IS 1573.

6 REQUIREMENTS

6.1 Freedom from Defects

The power connectors shall be reasonably — smooth and free from cavities, blow-holes and such other defects which would be likely to cause them to be unsatisfactory in service.

6.2 Power connectors shall be so designed and proportioned that they are capable of safely withstanding stresses to which they may be subjected (including those due to short-circuit and climatic conditions) and that the effects of vibration both on the conductor and the connector itself are minimized. They shall be designed, manufactured and finished so as to avoid sharp radii of curvature, ridges and excrescences which might lead to localized pressure on or damage to the conductor in service.

6.3 In bolted connectors that conduct rated normal current, the tightening of electrical conducting contact surface area must be done at least with four bolts. The minimum number of bolts per current carrying joint shall be four except parallel groove connectors, which connects single conductor to single conductor.

6.4 Expansion connectors shall permit a total movement of one conductor in relation to the other as follows:

a) For copper conductors – 31.8 mm, *Min*
b) For aluminium conductors or combination of aluminium and copper – 50.8 mm, *Min*

6.5 Bimetallic connectors shall be used to connect conductors of two dissimilar metals.

Sufficient contact pressure should be maintained at the joint by the provision of the required number of bolts or other fixing arrangements. But the contact pressure should not be so great as to cause relaxation of the joint by cold flow. The joint should be such that the pressure is maintained within this range under all conditions of service. To avoid excessive local pressure, the contact pressure should be evenly distributed by the use of pressure plates, washers or suitable saddles of adequate area and thickness.

7 LIMITS OF TEMPERATURE-RISE

7.1 Electrical Power Connectors

The temperature-rise of an electric power connector at rated current shall not exceed the temperature-rise of the conductor with which it is intended to be used.

The temperature-rise of an electric power connector that connects conductors of varying sizes shall not exceed the temperature-rise of the conductor having the highest temperature rise. For equipment terminal connector, **7.2**.

NOTE — The clamps are specified for service at an altitude up to 1 000 m. If the clamps are used at an altitude above 1 000 m, a correction factor, if any as mutually agreed between the manufacturer and the purchaser may be applicable.

7.2 Equipment Terminal Connectors

The temperature-rise of equipment terminal connectors that connects conductors of varying sizes and equipment terminal shall not exceed the temperature-rise of the conductor or terminal, having the highest temperature rise. The maximum temperature rise of equipment terminal connectors above a reference of ambient temperature of 40° C, when carrying rated current shall not exceed 45° C.

7.3 Expansion (or) Flexible Electric Power Connectors

The average temperature-rise of an expansion electric power connector shall be in accordance with **7.1**. The hot spot temperature-rise shall not exceed the average temperature rise by more than 10°C.

On expansion connectors measurement shall be made in accordance with the following:

a) Thermocouples shall be attached to the top surface of the flexible element(s) at the center of the free length.
b) The temperature of each flexible element(s) forming the entire connector shall be measured.
c) All of the temperature measurements shall be averaged to obtain the average temperature-rise of the expansion connector.

8 PROTECTION AGAINST CORROSION

8.1 All parts of power connectors shall either be inherently resistant to atmosphere corrosion or be suitably protected against corrosion, both during storage and in service.

8.2 All ferrous metal parts intended for outdoor use, except those made of stainless steel, shall be protected by hot-dip galvanizing in accordance with IS 2633 and IS 2629. Bolts, nuts and plain washers for the sizes below M12 and spring washers shall be electro-galvanized.

8.3 The threads of nuts and tapped holes shall be cut after galvanizing and shall be well oiled or greased. All other threads shall be cut before galvanizing.

9 MARKING

9.1 The connectors shall be indelibly marked with rated current or any identifying mark to enable full particulars of the connector to be obtained.

9.2 The product may also be marked with the Standard Mark.

9.2.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

10 TESTS

10.1 Following shall be the tests to be carried out on the connector.

10.1.1 *Type Tests*

NOTE — Because of the variety of types, ratings and possible combinations, it is impracticable to type test all arrangements of busbars and busbar connections. The performance of any particular arrangement can be substantiated by test data and experience in service on comparable arrangements and such data is considered as evidence of compliance with the requirement of this specification.

The following type tests shall be carried out on three samples.

a) Pull out strength test (*see* **11**),
b) Resistance test (*see* **12**),
c) Temperature-rise test (*see* **13**),
d) Short time current test. (*see* **14**),
e) Visual corona and RIV test (for 132 kV and above voltage level) (*see* **15**),
f) Cantilever strength test on bus support clamps and connectors (*see* **17**),
g) Dimensional check (*see* **19**), and
h) Galvanizing test, where applicable (*see* **20**).

10.1.2 *Acceptance Tests*

a) Pull out strength test (*see* **11**),
b) Resistance test (*see* **12**),
c) Torque strength test of bolted connectors (*see* **16**),
d) Visual examination (*see* **18**),
e) Dimensional check (*see* **19**), and
f) Galvanizing test, where applicable (*see* **20**).

10.1.3 *Routine Tests*

a) Visual examination (*see* **16**), and
b) Dimensional check (*see* **17**).

10.2 For acceptance tests the number of samples to be tested shall be the nearest whole number to 0.5 percent of the batch offered for acceptance. If these samples meet the test requirements, the batch is deemed to comply with the standard. In the event of the sample not meeting the requirements, twice the original number of new samples shall be tested. If all these new samples meet the test requirements, the batch is deemed to comply with the standard, but if any fails to do so, the batch is deemed not to comply with the standard.

11 PULL OUT STRENGTH TEST

11.1 The joint shall be assembled using the connector under test in accordance with the manufacturer's recommendations, on conductors of the sizes and types with which it is to be used.

11.2 The assembly shall be mounted in a tensile testing machine (or) rig and anchored in such a way that the test load is applied in the direction of the conductor.

11.3 The minimum pull out strength of connectors shall be 1 100 N. The connector shall be fastened to the conductor and the clamping bolts tightened in accordance with the manufacturer's recommendation. The conductor shall be marked in such a way that movement relative to the conductor can easily be detected. The load shall be steadily raised to 1 100 N in 1 min. There shall be no movement of the conductor relative to the connector due to slip during this 1 min period and no failure of the connector.

12 RESISTANCE TEST

12.1 The largest conductor which the electric power connector will accommodate shall be used during the resistance test.

12.2 The resistance measurements shall be made by millivolt drop with the help of an accurate resistance bridge or other suitable means.

12.3 The resistance of 1.25 m of a conductor, including one connector, such as splices or elbow, shall not exceed the resistance of 1.25 m of the identical conductor without connectors, by more than 10 percent. For terminal connectors, the resistance measured shall be the sum of the resistance measurements taken from *A* to *B* and *C* to *D* as shown in Fig. 1. In cases where the conductor is a stranded cable, the strands shall be suitably bonded at the point of measurement.

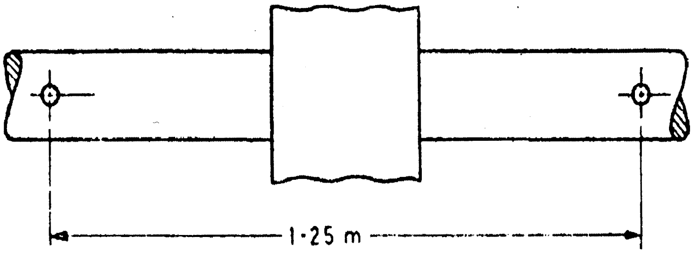
13 TEMPERATURE-RISE TEST

13.1 The values of the currents to be used in making temperature-rise tests for the various general types of connectors shall be determined in accordance with the following:

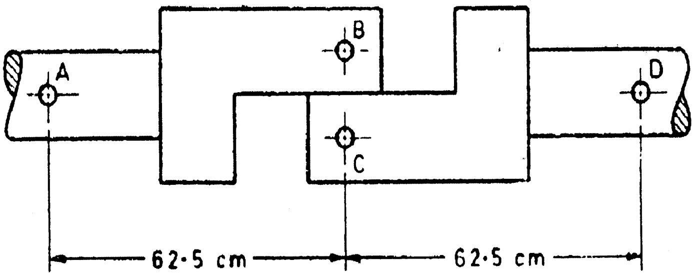
a) *Equipment Connectors* — The values of current shall be selected on the basis of the rating of the equipment to which the connector is connected or on the basis of the rating of the conductor for which the opening is designed, whichever is lower.
b) *Function Connectors* — The values of current shall be selected on the basis of the conductor which has the lower current carrying value where the openings are of two sizes and on the basis of the conductor which is common to both openings where the openings are of the same size.
c) *'T' Connectors* — The values of current shall be selected on the basis of the rating of the main and tap conductor which has the lower current carrying value.

13.2 The test of temperature-rise for power connectors shall be made with alternating current at an average frequency not below 95 percent of the rated frequency.

13.3 The connector shall be assembled indoors in accordance with the manufacturer's recommendations on conductors of size and type with which it is to be used. Air shall be freely circulated around the assembly. No draughts shall be allowed.



SPLICES



TERMINAL CONNECTORS

FIG.1 TERMINAL CONNECTORS AND SPLICES

13.4 The thermocouples mounted in the connectors are to be placed as close as possible to the zone of current flow between the connector and conductor.

13.5 Each test shall be made over a period of time sufficient for the temperature to reach an equilibrium condition (for practical purposes, this condition is attained when the variation does not exceed ± 1° C per h). Measurement shall be made at the end of the first 30 min and at one hour internals thereafter until completion of the test. Temperature measurements shall be made using either thermometer or thermocouple.

13.6 The time for the whole test may be shortened by preheating the circuit with a higher value of current.

14 SHORT-TIME CURRENT TEST

14.1 The test shall be arranged, as far as practicable, to produce conditions equivalent to those which would obtain in service when the connector under test carries fault current. The test may be made at any suitable voltage, and with the connector at any convenient temperature. The short-time current shall be applied for the specified time, and its r.m.s. value shall be determined from the oscillogram as indicated in Annex A.

14.2 The r.m.s. value of the short-time current shall be not less than the rated short-time current, and the highest peak value of the major current loop during the first cycle of the test shall be not less than the rated making capacity of any directly associated circuit-breaker or switch.

14.3 Where, however, the characteristics of test plant are such that the above requirements cannot be met, the following deviations are permitted provided that in (a) and (b) below the product of the square of the short-time current and the duration is not less than the product of the square of the rated short-time current and the rated time.

a) If the decrement associated with the test is such that the rated short-time current, measured in accordance with Annex A, cannot be obtained for the rated short-time duration without applying initially an excessively high current, the current may be permitted to fall during the test below the specified value and the duration of the test increased appropriately, provided that the initial value of both peak and r.m.s. current are not less than those set out above.

b) If in order to obtain the required initial peak value, the r.m.s. value of the short-time current is increased above the value of the rated short-time current, the duration of the may be reduced below the rated short-time duration.

14.4 The short-time current shall not produce any mechanical damage, such as permanent distortion or burning of parts, and shall not cause a temperature-rise that, added to the maximum temperature attained at rated current, would damage the current-carrying parts.

15 CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

15.1 This test shall be applicable for connectors of system operating voltage of 132 kV and above.

15.2 The connectors shall be tested for external corona both by observing the voltage level for the extinction of visible corona under falling power frequency voltage. Observation for visual corona shall be made in a darkened area after the eye has adapted to the dark. Binoculars or image amplification equipment can be used to locate and observe the presence of corona.

15.3 RIV tests shall be made according to measuring circuit as per IS 10052 (Part 1). The measuring circuit shall preferably be tuned at a frequency of 0.5 MHz or 1 MHz or alternatively other frequencies between 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The RIV results shall be in microvolt.

15.4 Test Set-up

Connectors shall be tested while assembled with the conductor on which they are to be used or dimensionally equivalent tubing shall be permitted to be substituted for stranded conductors. The connector and conductor to be tested shall be in a clean, dry condition and test shall be conducted on new connectors or conductors. It is permitted to wipe the mounting insulators, connectors and busbars with a clean cloth before taking measurements.

15.4.1 *Test Voltage Levels*

The test voltage levels for measurement of external RIV and for corona extinction voltage are listed below

Test voltage (kV) : for 765 kV system operating voltage — 508 kV r.m.s.
for 400 kV system operating voltage — 320 kV r.m.s.
for 220 kV system operating voltage — 156 kV r.m.s.
for 132 kV system operating voltage — 105 kV r.m.s

For system operating voltage other than listed above , the test voltage levels for measurement of external RIV and for corona extinction voltage shall be at least 110 percent of the height system operating voltage (equal to the highest system voltage divides by square root of three) or as agreed between the purchaser and the supplier.

15.4.2 *Test Methods for Visible Corona*

The power frequency voltage shall be raised to 110 percent of test voltage and maintained the voltage for 5 min. In case of corona inception does not take place at 110 percent, test shall be stopped, otherwise test shall be continued and the voltage will then be decreased slowly until all visible corona disappears, then the voltage increased slowly until visible corona appears. The procedure shall be repeated at least four times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which visible corona disappears. Inception and extinction of visual corona for each of the four test shall be recorded.

15.4.3 *Test Methods for RIV*

110 percent of the specified test voltage shall be applied to the connectors or conductors under test and maintained for at least 5 min. The voltage shall then be decreased in steps to 30 percent of the specified test voltage, raised in steps to the initial value, maintained there for 1 min and finally decreased in steps to the 30 percent value. Each voltage step shall be approximately 10 percent of the specified test voltage

At each step a radio interference measurement shall be made and the results obtained during the last decreasing run shall be plotted against the applied voltage. The curve so obtained is the RI characteristic of the connector or conductor.

Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurement

The RIV level of a test sample shall be considered acceptable as long as the measured RIV level, which includes both the test area ambient and test sample RIV is below the limit.

15.4.4 *Acceptance Criteria for Corona and RIV*

Corona extinction voltage (kV):

for 765 kV system operating voltage — 508 kV r.m.s.
for 400 kV system operating voltage — 320 kV r.m.s.
for 220 kV system operating voltage — 156 kV r.m.s.
for 132 kV system operating voltage — 105 kV r.m.s.

Maximum permissible Radio Interference level (mV):

for 765 kV system operating voltage — Less than 2 500 mV at 508 kV r.m.s.
for 400 kV system operating voltage — Less than 1 000 mV at 320 kV r.m.s.
for 220 kV system operating voltage — Less than 1 000 mV at 156 kV r.m.s.

for 132 kV system operating voltage —
Less than 500 mV
at 105 kV r.m.s.

NOTE — In cases where a corona glow effect occurs below the required corona extinction, it is permissible to clean the fittings surface with a clean dry cloth.

16 TORQUE STRENGTH TEST OF BOLTED CONNECTORS

The purpose of this is to ensure mechanical integrity of connector casting which shall also be considered as an alternative test to tensile test for castings as per **10.2** of IS 617. The conductor(s) shall be assembled in the connector and the bolts torqued uniformly and alternatively in increments until 50 percent over the manufactures recommended torque value is achieved. The connector shall withstand without damage a torque value 50 percent over the manufacturers recommended torque value. Damage is defined as any crack or opening detected by the naked eye. This torque test is intended to verify the mechanical integrity of connector castings and not the bolts.

17 CANTILEVER STRENGTH TEST ON BUS SUPPORT CLAMPS AND CONNECTORS

The cantilever strength shall be determined by applying a load transverse to the conductor longitudinal axis. The bus support shall be bolted to a flat surface, using the hardware recommended by the manufacturer. The minimum cantilever strength of bus support clamps and connectors shall be 8 896 N for aluminum and 2 224 N for copper alloy.

18 VISUAL EXAMINATION

The clamps and connectors shall be checked visually for the following:

a) electrical contact surface area of the connectors which carry rated normal current shall satisfy the requirements given in **6.1**.
b) shall be free from manufacturing defects such as cavities, blow holes and such others defect which would be likely if cause them to be unsatisfactory in service.

19 DIMENSIONAL CHECK

The dimensions of the connectors shall be checked against drawings and gauges.

20 GALVANIZING TEST

The quality of hot-dip galvanized ferrous components shall be determined by the tests given in IS 2633 and shall satisfy the requirements of that standard.

ANNEX A

(*Clause* 14.1)

DETERMINATION OF SHORT-TERM CURRENT

A-1 The method illustrated in Fig. 2 should be used to determine the short-time current.

A-2 The total time BT of the test is divided into ten equal parts by verticals 0 to 10 and the r.m.s value of the ac component of the current is measured at these verticals.

These values are designated I_0, I_1.................I_{10}.

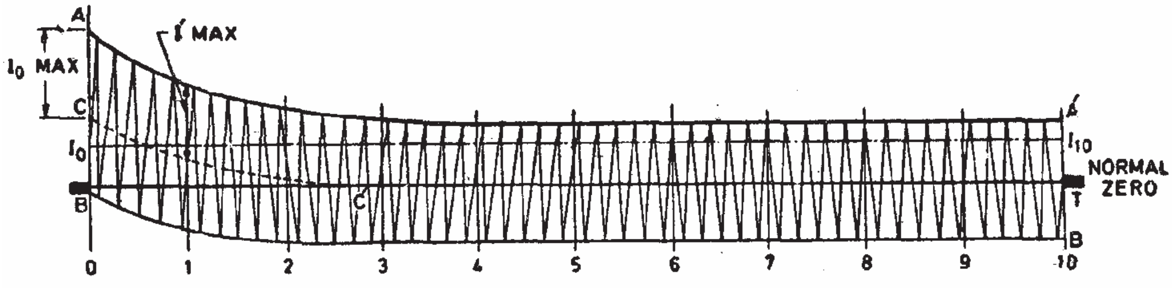
where

$$I = \frac{I_{\text{Max}}}{\sqrt{2}}$$

being the peak value of ac component of current.

A-3 For the purpose of this standard the dc component of current represented by is neglected since in practice its inclusion in the determination is of negligible effect.

A-4 The equivalent r.m.s current during the time BT is given by:



$$\sqrt{(1/30[I_0^2 + 4(I_1^2 + I_3^2 + I_5^2] + I_7^2 + I_9^2) + 2(I_2^2 + I_4^2 + I_6^2 + I_8^2) + I_{10}^2}$$

$\left.\begin{matrix}AA'\\BB'\end{matrix}\right\}$	Envelope of current wave.
CC'	Displacement of current wave zero line from normal zero line at any instant.
$I_0 I_{10}$	R.M.S. value of ac component of current at any instant measured from normal zero. DC component is neglected.
I°*Max*	Peak value of ac component of current at instant of imitating short-circuit.
I'*Max*	Peak value of ac component of current at time division I.
BT	Duration of short-circuit.

FIG. 2 DETERMINATION OF SHORT-TIME CURRENT

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Amendments Issued Since Publication

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